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Ikemoto et al.

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(54) **DATA COLLECTION METHOD, MOBILE TERMINAL AND DATA STORAGE DEVICE**

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(73) Assignee: **FUJITSU LIMITED**, Kawasaki (JP)

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H04M 3/00 (2006.01)
H04W 28/06 (2009.01)
H04W 4/00 (2009.01)

(52) **U.S. Cl.**
CPC ***H04W 28/06*** (2013.01); ***H04W 4/006*** (2013.01); *H04W 4/008* (2013.01)

(58) **Field of Classification Search**
CPC H04W 28/06; H04W 4/008; H04W 4/006
USPC 455/41.1, 41.2, 418–420, 500, 507, 455/517, 550.1, 552.1, 553.1
See application file for complete search history.

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(57) **ABSTRACT**

A first mobile terminal requests a device to transmit data, on the basis of a processing request transmitted from a management server. The device transmits the requested data to the first mobile terminal. The first mobile terminal generates processed data by using the data received from the device. The first mobile terminal assigns an identifier to the processed data. The first mobile terminal transmits the processed data in association with the identifier to the management server. The first mobile terminal transmits an association relationship between the identifier and the data used for generating the processed data to the device. The device stores the identifier in association with the transmitted data. A second mobile terminal transmits to the device an identifier transmitted from the management server as an identifier associated with data to be deleted. The device identifies data associated with the identifier received from the second mobile terminal.

3 Claims, 14 Drawing Sheets

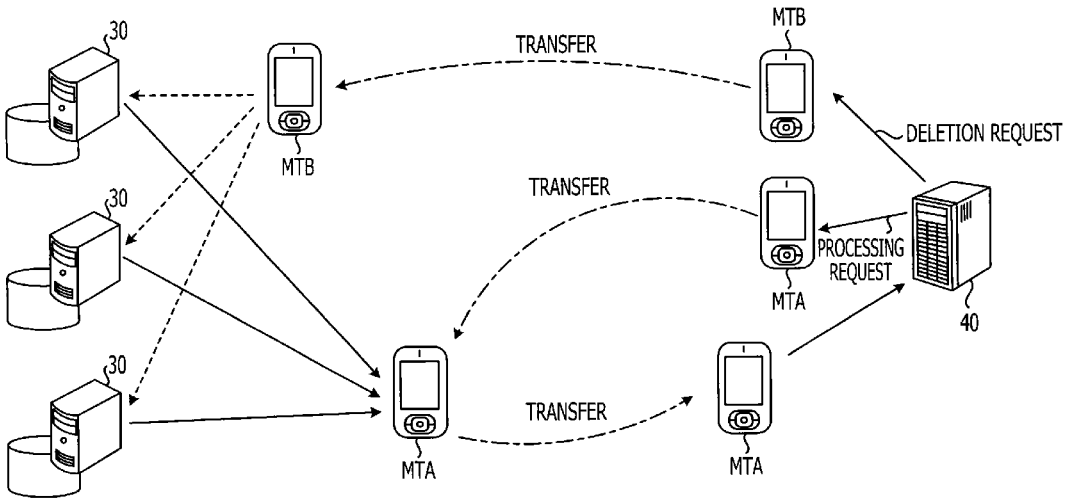


FIG. 1

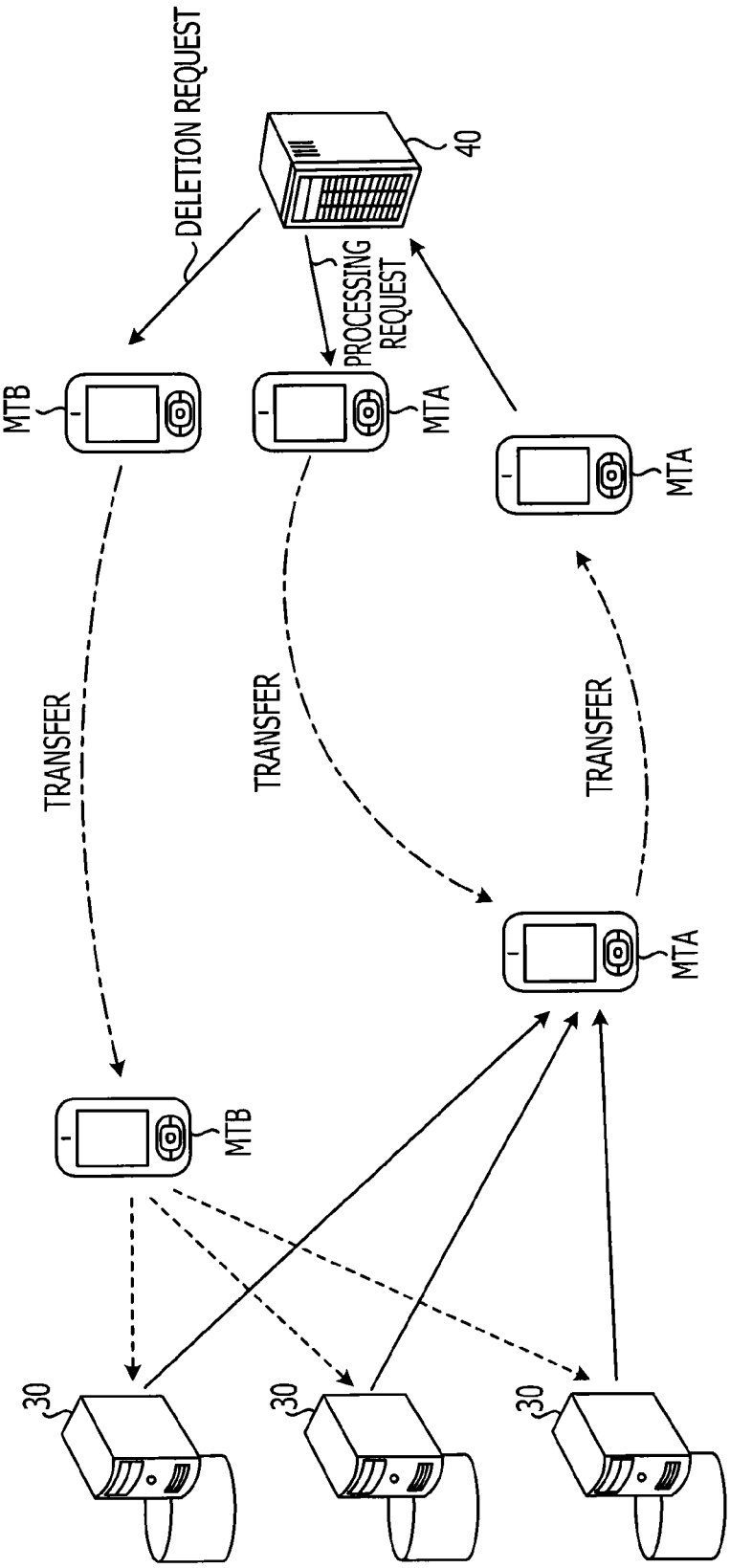

DELETION REQUEST
40
PROCESSING REQUEST
MTB
MTA
MTA
TRANSFER
TRANSFER
TRANSFER
MTA
MTB
30
30
30

FIG. 2

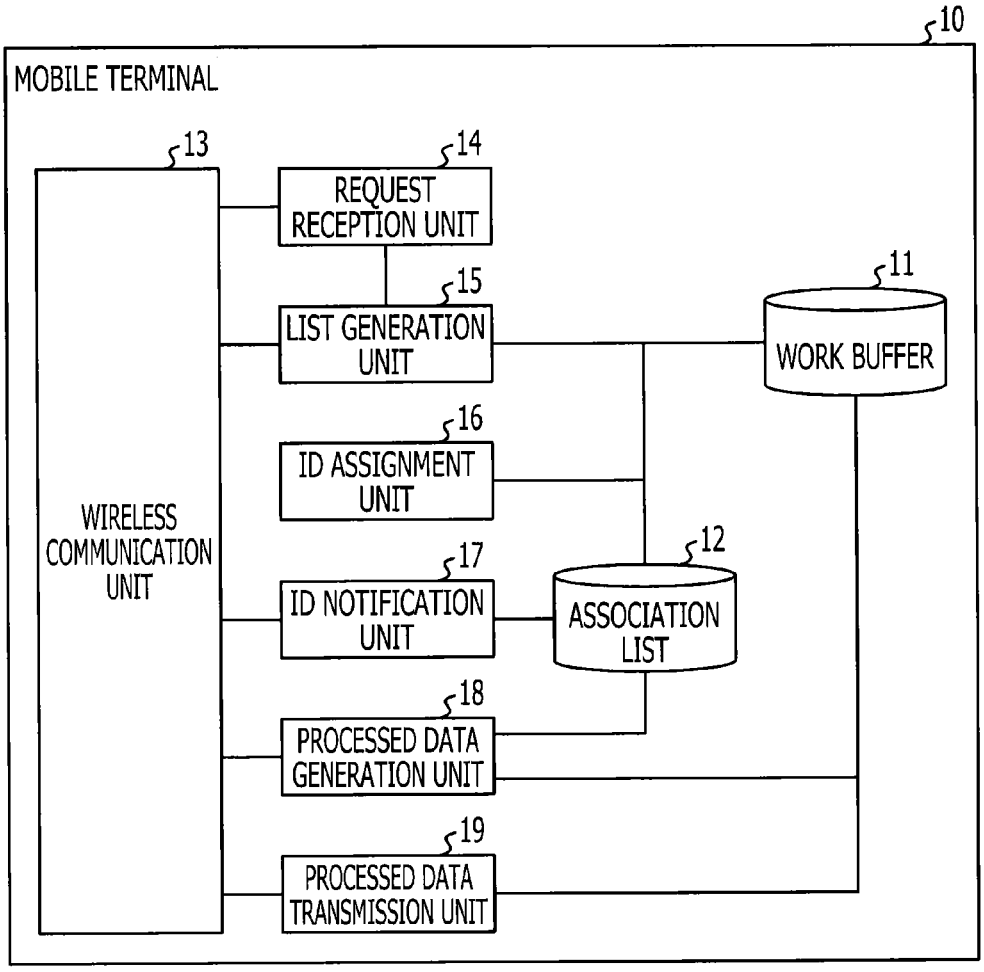

10
MOBILE TERMINAL
13
WIRELESS COMMUNICATION UNIT
14
REQUEST RECEPTION UNIT
15
LIST GENERATION UNIT
16
ID ASSIGNMENT UNIT
17
ID NOTIFICATION UNIT
18
PROCESSED DATA GENERATION UNIT
19
PROCESSED DATA TRANSMISSION UNIT
11
WORK BUFFER
12
ASSOCIATION LIST

FIG. 3

PROCESSED DATA NAME	CONSTITUENT ELEMENTS	RECEPTION STATES
PD_1	RD_1	RECEIVED
	RD_2	NOT RECEIVED
	RD_3	RECEIVED
	RD_4	NOT RECEIVED

FIG. 4

PROCESSED DATA NAME	UNIQUE ID	CONSTITUENT ELEMENTS
PD_1	001	RD_1
		RD_2
		RD_3
		RD_4

FIG. 5

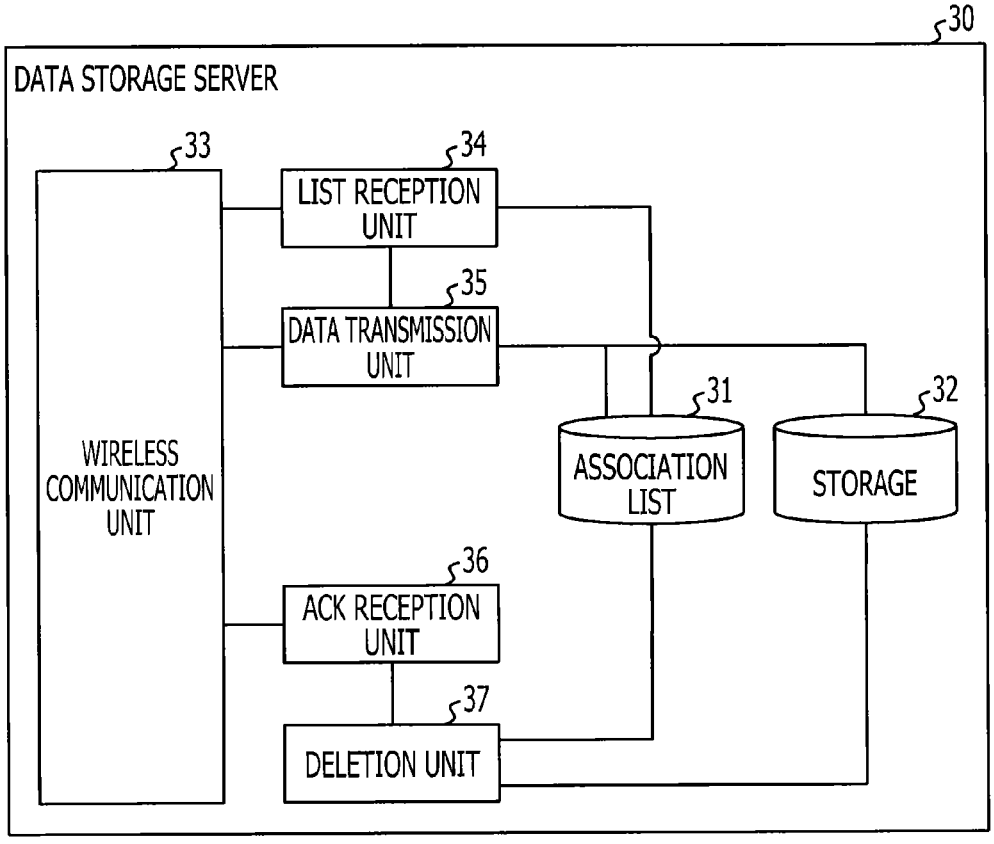

30
DATA STORAGE SERVER
33
34
LIST RECEPTION UNIT
35
DATA TRANSMISSION UNIT
31
32
ASSOCIATION LIST
STORAGE
WIRELESS COMMUNICATION UNIT
36
ACK RECEPTION UNIT
37
DELETION UNIT

FIG. 6

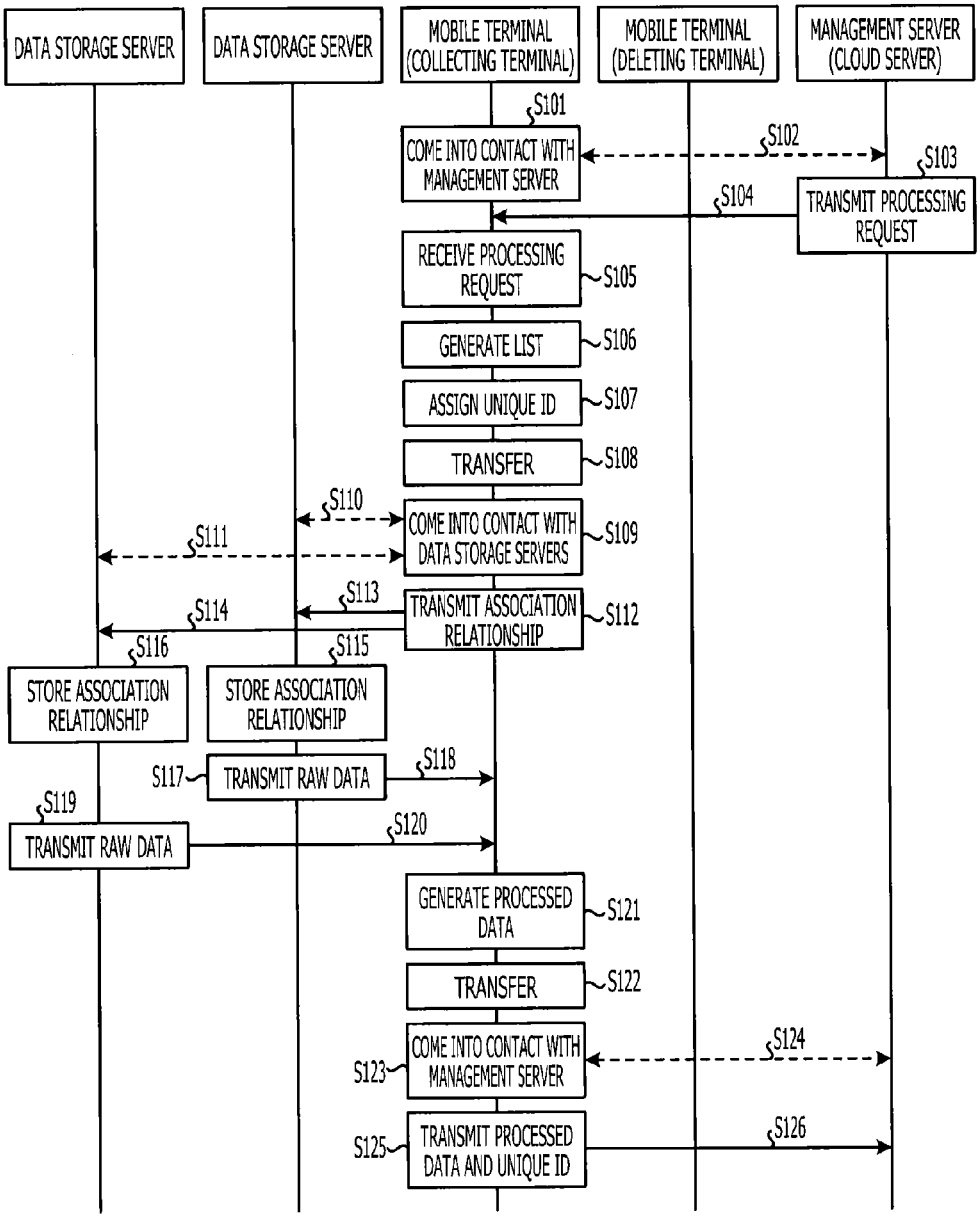

DATA STORAGE SERVER
DATA STORAGE SERVER
MOBILE TERMINAL (COLLECTING TERMINAL)
MOBILE TERMINAL (DELETING TERMINAL)
MANAGEMENT SERVER (CLOUD SERVER)
S101
COME INTO CONTACT WITH MANAGEMENT SERVER
S102
S103
TRANSMIT PROCESSING REQUEST
S104
RECEIVE PROCESSING REQUEST
S105
GENERATE LIST
S106
ASSIGN UNIQUE ID
S107
TRANSFER
S108
S110
S111
COME INTO CONTACT WITH DATA STORAGE SERVERS
S109
S113
S114
TRANSMIT ASSOCIATION RELATIONSHIP
S112
S116
S115
STORE ASSOCIATION RELATIONSHIP
STORE ASSOCIATION RELATIONSHIP
S117
TRANSMIT RAW DATA
S118
S119
TRANSMIT RAW DATA
S120
GENERATE PROCESSED DATA
S121
TRANSFER
S122
S123
COME INTO CONTACT WITH MANAGEMENT SERVER
S124
S125
TRANSMIT PROCESSED DATA AND UNIQUE ID
S126

FIG. 7

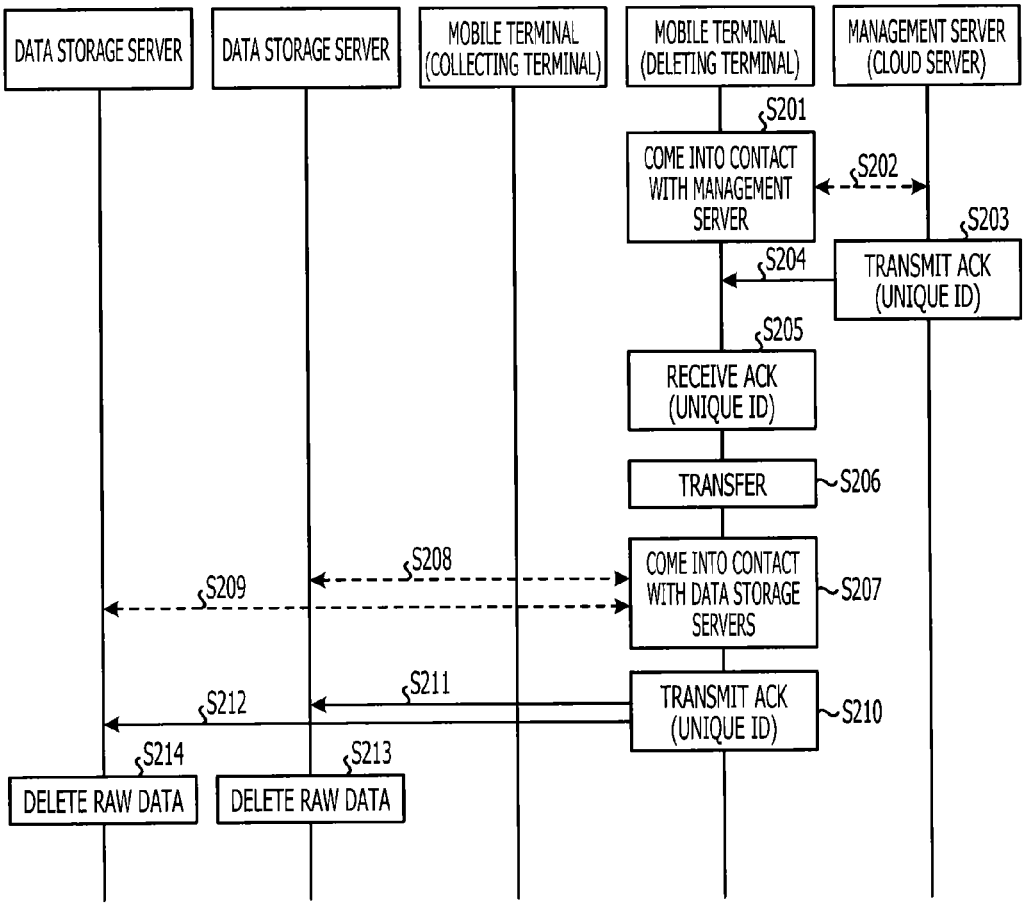

DATA STORAGE SERVER
DATA STORAGE SERVER
MOBILE TERMINAL (COLLECTING TERMINAL)
MOBILE TERMINAL (DELETING TERMINAL)
MANAGEMENT SERVER (CLOUD SERVER)
S201
COME INTO CONTACT WITH MANAGEMENT SERVER
S202
S203
TRANSMIT ACK (UNIQUE ID)
S204
S205
RECEIVE ACK (UNIQUE ID)
TRANSFER
S206
S208
S209
COME INTO CONTACT WITH DATA STORAGE SERVERS
S207
S211
S212
TRANSMIT ACK (UNIQUE ID)
S210
S214
S213
DELETE RAW DATA
DELETE RAW DATA

FIG. 8

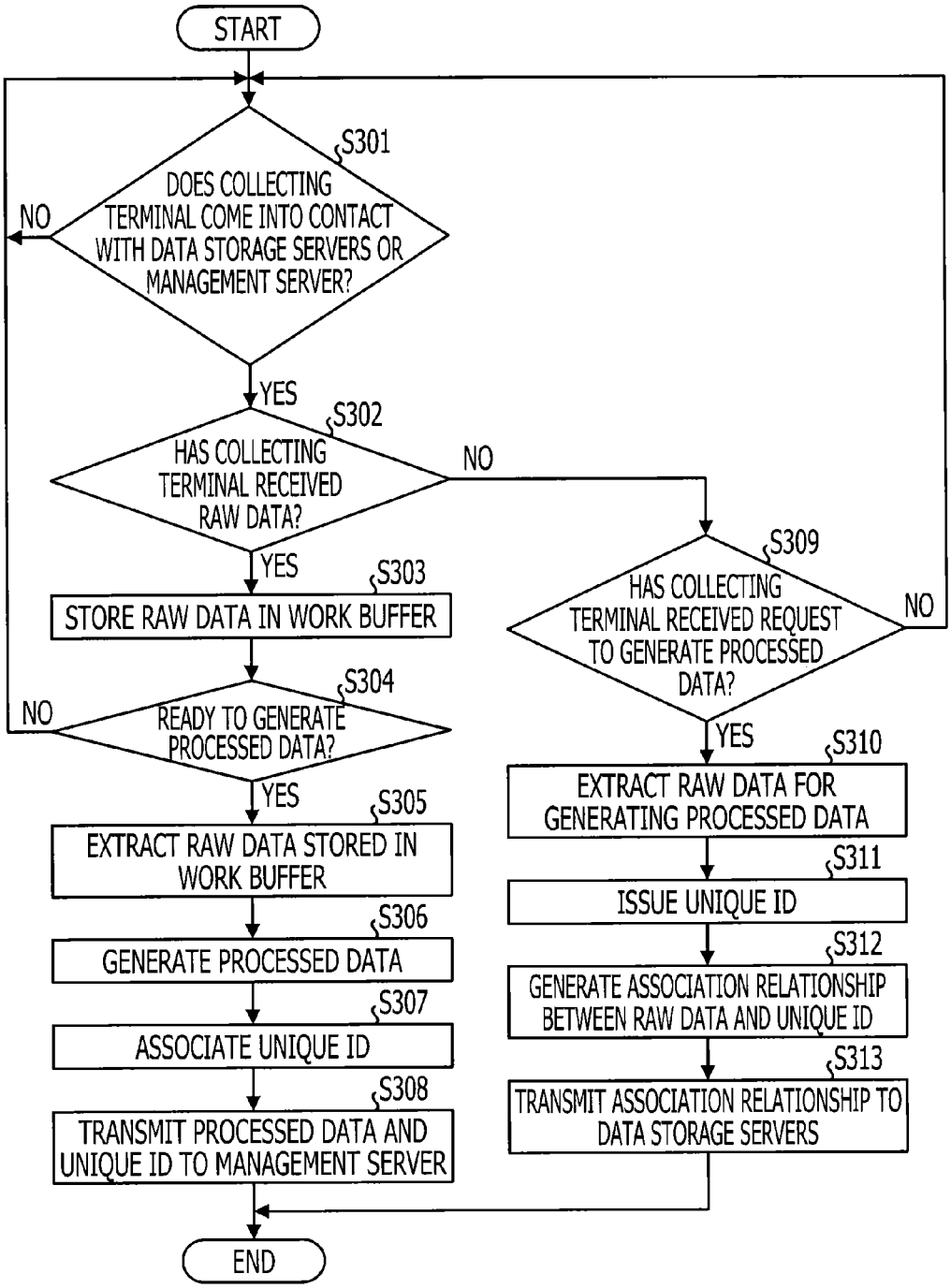

START
S301
DOES COLLECTING TERMINAL COME INTO CONTACT WITH DATA STORAGE SERVERS OR MANAGEMENT SERVER?
NO
YES
S302
HAS COLLECTING TERMINAL RECEIVED RAW DATA?
NO
YES
S303
STORE RAW DATA IN WORK BUFFER
S304
READY TO GENERATE PROCESSED DATA?
NO
YES
S305
EXTRACT RAW DATA STORED IN WORK BUFFER
S306
GENERATE PROCESSED DATA
S307
ASSOCIATE UNIQUE ID
S308
TRANSMIT PROCESSED DATA AND UNIQUE ID TO MANAGEMENT SERVER
S309
HAS COLLECTING TERMINAL RECEIVED REQUEST TO GENERATE PROCESSED DATA?
NO
YES
S310
EXTRACT RAW DATA FOR GENERATING PROCESSED DATA
S311
ISSUE UNIQUE ID
S312
GENERATE ASSOCIATION RELATIONSHIP BETWEEN RAW DATA AND UNIQUE ID
S313
TRANSMIT ASSOCIATION RELATIONSHIP TO DATA STORAGE SERVERS
END

FIG. 9

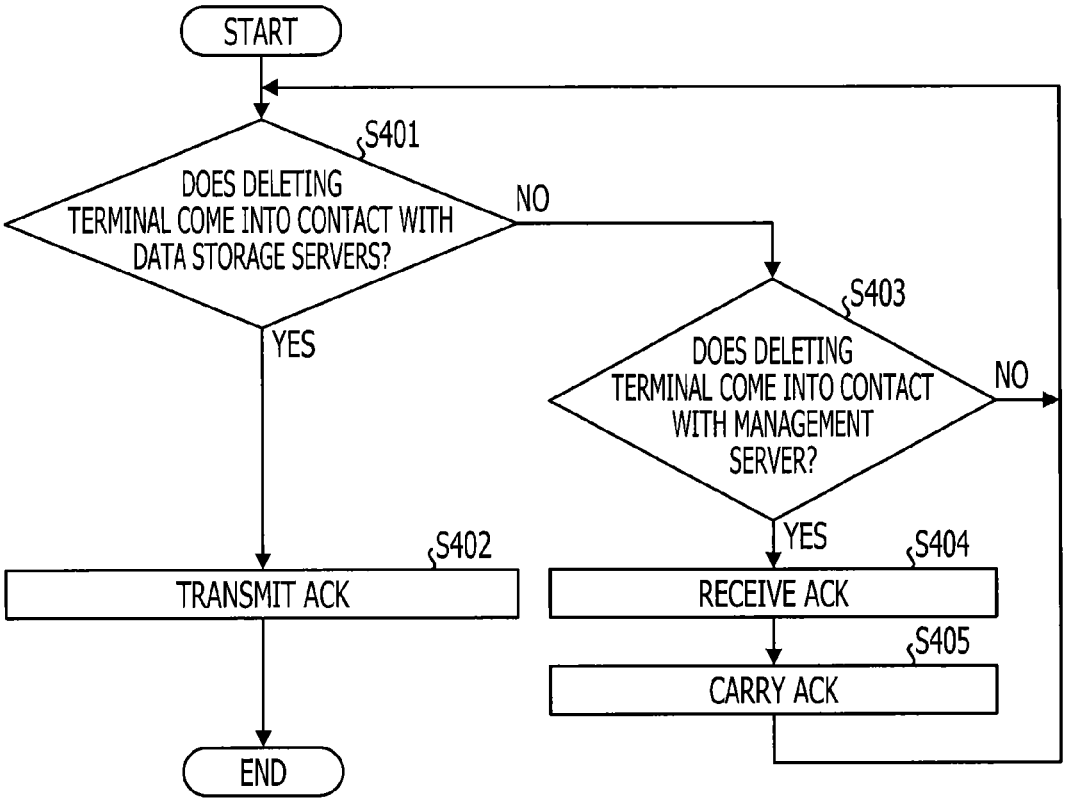

START
S401
DOES DELETING TERMINAL COME INTO CONTACT WITH DATA STORAGE SERVERS?
NO
YES
S403
DOES DELETING TERMINAL COME INTO CONTACT WITH MANAGEMENT SERVER?
NO
YES
S402
TRANSMIT ACK
S404
RECEIVE ACK
S405
CARRY ACK
END

FIG. 10

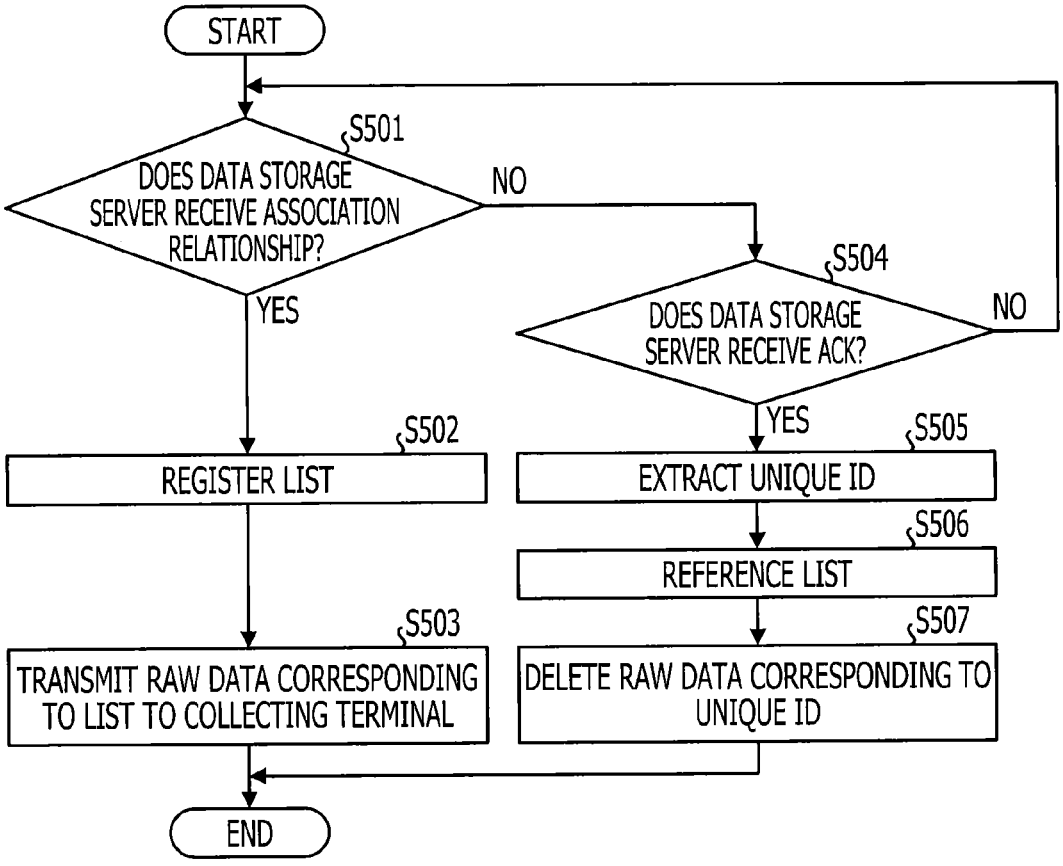

START
S501
DOES DATA STORAGE SERVER RECEIVE ASSOCIATION RELATIONSHIP?
NO
YES
S504
DOES DATA STORAGE SERVER RECEIVE ACK?
NO
YES
S502
REGISTER LIST
S505
EXTRACT UNIQUE ID
S506
REFERENCE LIST
S503
TRANSMIT RAW DATA CORRESPONDING TO LIST TO COLLECTING TERMINAL
S507
DELETE RAW DATA CORRESPONDING TO UNIQUE ID
END

FIG. 11

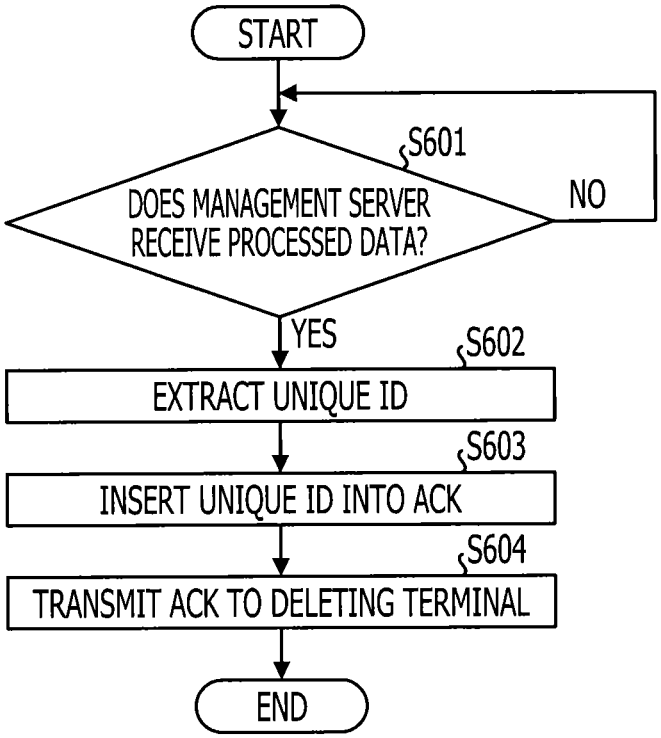

START
S601
DOES MANAGEMENT SERVER RECEIVE PROCESSED DATA?
NO
YES
S602
EXTRACT UNIQUE ID
S603
INSERT UNIQUE ID INTO ACK
S604
TRANSMIT ACK TO DELETING TERMINAL
END

FIG. 12

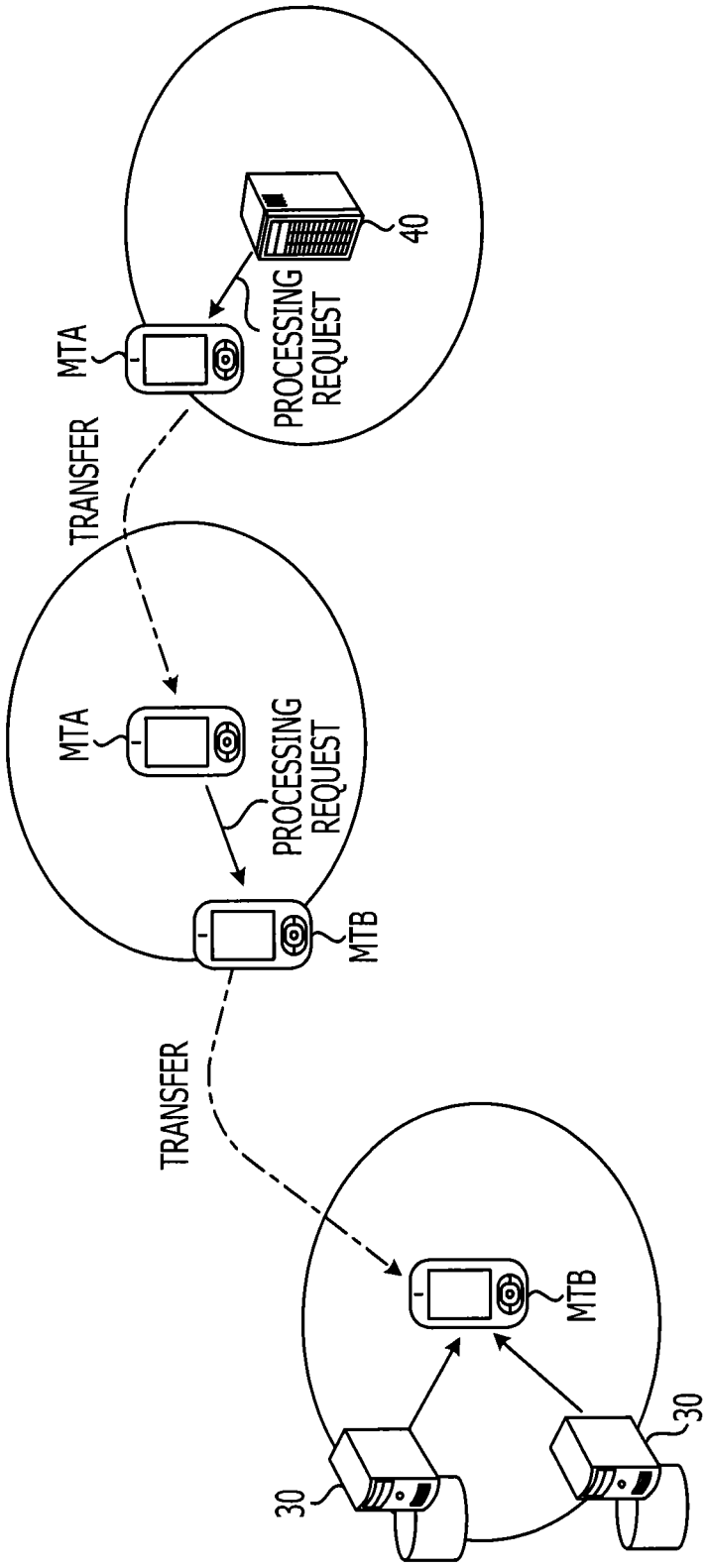

40
PROCESSING REQUEST
MTA
TRANSFER
MTA
PROCESSING REQUEST
MTB
TRANSFER
MTB
30
30

FIG. 13

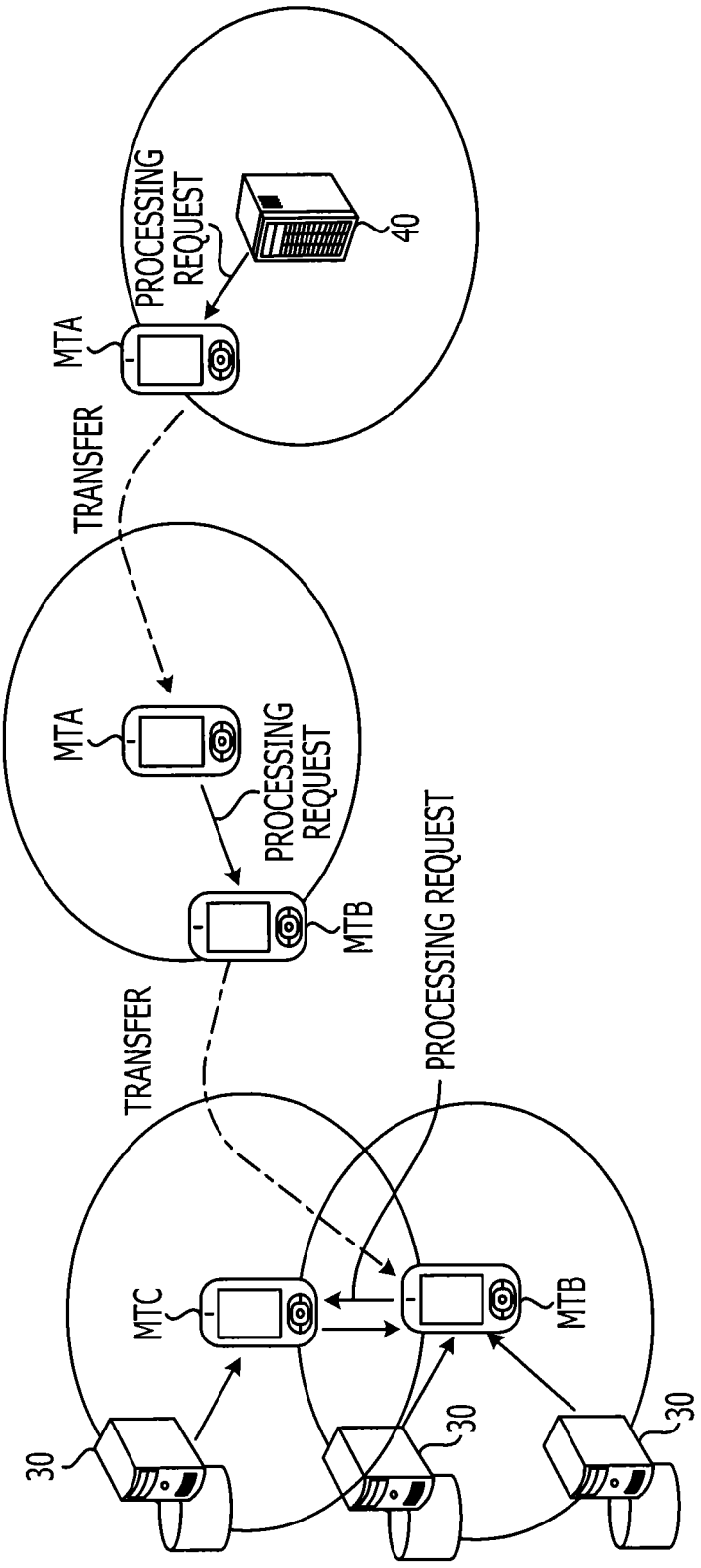
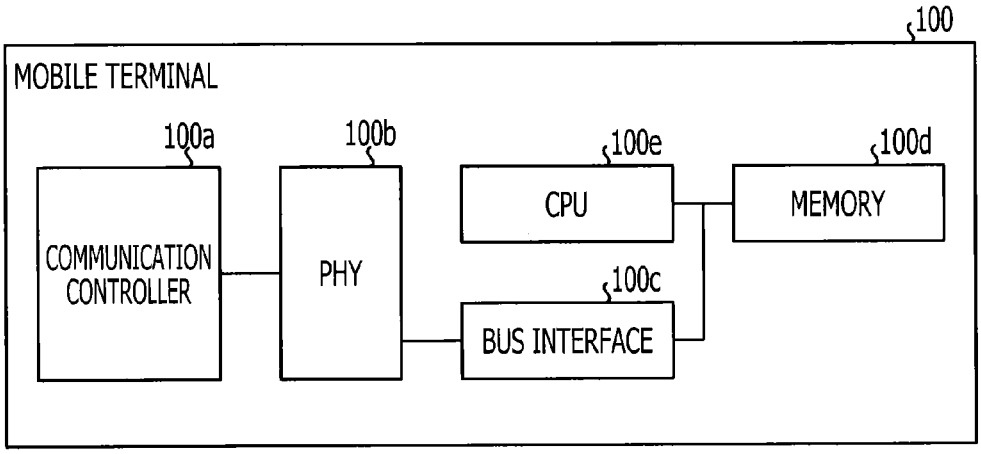

PROCESSING REQUEST
40
MTA
TRANSFER
MTA
PROCESSING REQUEST
MTB
TRANSFER
PROCESSING REQUEST
MTC
MTB
30
30
30

FIG. 14


100
MOBILE TERMINAL
100a
COMMUNICATION CONTROLLER
100b
PHY
100e
CPU
100d
MEMORY
100c
BUS INTERFACE

DATA COLLECTION METHOD, MOBILE TERMINAL AND DATA STORAGE DEVICE

CROSS-REFERENCE TO RELATED APPLICATION

This application is based upon and claims the benefit of priority of the prior Japanese Patent Application No. 2012-077853, filed on Mar. 29, 2012, the entire contents of which are incorporated herein by reference.

FIELD

The embodiments discussed herein are related to a data collection method, a mobile terminal and a data storage device.

BACKGROUND

In recent years, M2M services that enable devices connected to a network to exchange information with each other without a person and automatically execute the optimal control are widely used. In addition, cloud systems that provide M2M services are becoming widely adopted. For example, there is a system in which wireless communication terminals form an ad-hoc network and a cloud server collects information such as sensor values from the wireless communication terminals.

In order to suppress an introduction cost, a phone line or a third generation network is used. For example, the cloud server collects operating states and states of consumable supplies from remote devices on behalf of customers. Then, customer monitoring agents use mobile phones to access the cloud server and figure out the states of the devices.

Japanese National Publication of International Patent Application No. 2002-512829 and Japanese Laid-open Patent Publication No. 2005-169090 disclose related techniques.

SUMMARY

According to an aspect of the present invention, provided is a data collection method. In the method, a first mobile terminal requests a device to transmit data, on the basis of a processing request transmitted from a management server. The device transmits the requested data to the first mobile terminal. The first mobile terminal receives the transmitted data. The first mobile terminal generates processed data by using the received data. The first mobile terminal assigns an identifier to the processed data. The first mobile terminal transmits the processed data in association with the identifier to the management server. The first mobile terminal transmits an association relationship between the identifier and the data used for generating the processed data to the device. The device stores the identifier in association with the transmitted data. A second mobile terminal transmits to the device an identifier transmitted from the management server as an identifier associated with data to be deleted. The device receives the identifier transmitted from the second mobile terminal. The device identifies data associated with the received identifier.

The object and advantages of the invention will be realized and attained by means of the elements and combinations particularly pointed out in the claims.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are not restrictive of the invention, as claimed.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a diagram illustrating an example of an overall configuration of a system according to a first embodiment;

FIG. **2** is a functional block diagram illustrating a configuration of a mobile terminal according to a first embodiment;

FIG. **3** is a diagram illustrating an example of information stored in a work buffer;

FIG. **4** is a diagram illustrating an example of information stored in an association list;

FIG. **5** is a functional block diagram illustrating a configuration of a data storage server according to a first embodiment;

FIG. **6** is a sequence diagram of data processing that is executed by a system according to a first embodiment;

FIG. **7** is a sequence diagram of data deletion that is executed by a system according to a first embodiment;

FIG. **8** is a flowchart of a process that is executed by a collecting terminal;

FIG. **9** is a flowchart of a process that is executed by a deleting terminal;

FIG. **10** is a flowchart of a process that is executed by a data storage server;

FIG. **11** is a flowchart of a process that is executed by a management server;

FIG. **12** is a diagram describing a flow in which mobile terminals relay a request;

FIG. **13** is a diagram illustrating an example in which a mobile terminal collects raw data through another mobile terminal; and

FIG. **14** is a diagram illustrating an example of hardware configurations of the mobile terminals.

DESCRIPTION OF EMBODIMENTS

A communication cost for the third generation network, however, is high. In addition, if the system is large, a load of the cloud server is high. Thus, it may be considered that the communication cost is suppressed by using Wireless Fidelity (Wi-Fi) instead of the third generation network and the load of the cloud server is reduced by causing terminals such as smart phones to process data or the like. In such a case, however, the amount of traffic in a network is large.

Smart phones that execute communication by using Wi-Fi will be described below as an example. A smart phone that is located near a cloud server receives a request to process data from the cloud server. The smart phone that has received the processing request collects the data to be used for the processing from a device and generates processed data. The smart phone transmits the processed data to the cloud server. Upon receiving the processed data, the cloud server transmits a deletion request to a smart phone located near the cloud server. The smart phone that has received the deletion request deletes the data used for the processing from the device.

In a system that uses Wi-Fi and smart phones, a terminal that collects data may be different from a terminal that deletes the data. Thus, devices manage an association relationship between processed data and data used for generating the processed data. The devices transmit and receive the processed data and the deletion request, which are accompanied with the data used for processing. As a result, the data amounts of packets become large and the amount of traffic in

a network becomes large. In addition, the system may cause a packet transmission error and a packet loss, thus reducing the reliability of the system.

Hereinafter, embodiments of a data collection method, a mobile terminal and a data storage device will be described in detail with reference to the accompanying drawings. The data collection method, the mobile terminal and the data storage device, however, are not limited to the embodiments.

First Embodiment

Overall Configuration of System

FIG. **1** is a diagram illustrating an example of an overall configuration of a system according to a first embodiment. As illustrated in FIG. **1**, the system includes a mobile terminal MTA, a mobile terminal MTB, data storage servers **30** and a management server **40**. In the system, the management server **40** and the data storage servers **30** do not directly execute data communication with each other. The number of mobile terminals, the number of servers and the like are examples and not limited to those illustrated in FIG. **1**.

The mobile terminals MTA and MTB are wireless communication devices such as smart phones or mobile phones and held by users. The mobile terminals MTA and MTB execute near field communication by using Wi-Fi or the like and may thereby wirelessly communicate with the data storage servers **30** and the management server **40**.

The data storage servers **30** are server devices that stores data. The data storage servers **30** store data generated by the devices, for example, backup results, system logs, error logs, and the like. The data storage servers **30** execute near field communication by using Wi-Fi or the like and may thereby wirelessly communicate with the mobile terminals MTA and MTB and the management server **40**.

The management server **40** is a server device that collects data held by the data storage servers **30** and manages the collected data. The management server **40** corresponds to a cloud server for the mobile terminals MTA and MTB. The management server **40** executes near field communication by using Wi-Fi or the like and may thereby wirelessly communicate with the mobile terminals MTA and MTB and the data storage servers **30**.

In the aforementioned state, the mobile terminal MTA comes close enough to the management server **40** to communicate with the management server **40** by using Wi-Fi, as the user of the mobile terminal MTA transfers. The management server **40** detects the presence of the mobile terminal MTA by using Wi-Fi and transmits a request to process data to the mobile terminal MTA. The mobile terminal MTA that has received the processing request comes close enough to the data storage servers **30** to communicate with the data storage servers **30** by using Wi-Fi, as the user of the mobile terminal MTA transfers.

Then, the mobile terminal MTA uses Wi-Fi to transmit, to the data storage servers **30**, a request to acquire raw data to be used for the data processing. After that, the mobile terminal MTA uses the raw data acquired from the data storage servers **30** to generate processed data and assigns a unique identifier (ID) to the generated processed data. In this example, the unique ID is assigned after the generation of the processed data. However, the unique ID may be assigned to the processed data to be generated, before the generation of the processed data.

The mobile terminal MTA transmits an association relationship between the raw data used for the processing and the unique ID to the data storage servers **30**. The data storage servers **30** hold the association relationship between the raw data transmitted to the mobile terminal MTA and the unique ID.

After that, the mobile terminal MTA that holds the processed data comes close enough to the management server **40** to communicate with the management server **40** by using Wi-Fi, as the user transfers. Then, the mobile terminal MTA transmits the processed data to the management server **40** by using Wi-Fi. In this manner, the management server **40** may collect the processed data generated from the data held by the data storage servers **30**.

When the management server **40** detects the presence of the mobile terminal MTB by using Wi-Fi, the management server **40** transmits an acknowledgment (ACK) containing the unique ID to the mobile terminal MTB. The ACK is a response corresponding to the request to process the data. The mobile terminal MTB that has received the ACK comes close enough to the data storage servers **30** to communicate with the data storage servers **30** by using Wi-Fi, the user of the mobile terminal MTB transfers.

Then, the mobile terminal MTB transmits the ACK to the data storage servers **30** by using Wi-Fi. The data storage servers **30** identify the raw data associated with the unique ID contained in the received ACK. After that, the data storage servers **30** delete the identified raw data, for example. In this manner, the management server **40** may delete the raw data used for generating the processed data by using the transfer of the mobile terminal MTB.

As described above, when the data storage servers **30** and the management server **40** communicate with each other by using the near field communication with a plurality of mobile terminals, a unique ID is associated with data to be transmitted from the data storage servers **30** to the management server **40**. The same unique ID is associated with an ACK to be transmitted from the management server **40** to the data storage servers **30**. Then, the ACK is transmitted. Thus, even when a terminal that collects data is different from a terminal that deletes the data, a common unique ID within the system may be transmitted, and the amount of traffic may be suppressed.

Configurations of Mobile Terminals

Next, configurations of the mobile terminals MTA and MTB illustrated in FIG. **1** will be described. The mobile terminals MTA and MTB have the same configuration and the same configuration will be described as a configuration of a mobile terminal **10**. FIG. **2** is a functional block diagram illustrating a configuration of the mobile terminal **10** according to the first embodiment.

As illustrated in FIG. **2**, the mobile terminal **10** includes a work buffer **11**, an association list **12**, a wireless communication unit **13**, a request reception unit **14**, a list generation unit **15**, an ID assignment unit **16**, an ID notification unit **17**, a processed data generation unit **18** and a processed data transmission unit **19**. These processing units of the mobile terminal **10** are achieved by causing a processor such as a central processing unit (CPU) to execute a program. The work buffer **11** is a storage device such as a memory or a hard disk. The association list **12** is held by a storage device such as a memory or a hard disk.

The work buffer **11** is a storage unit that stores information used by the processed data generation unit **18** to generate processed data or the like. FIG. **3** is a diagram illustrating an example of the information stored in the work buffer **11**. As illustrated in FIG. **3**, the work buffer **11** stores "a processed data name, constituent elements, and reception states" in association with one another. The information stored in the

work buffer **11** is generated and updated by the list generation unit **15** and the processed data generation unit **18**.

The "processed data name" is an identifier that identifies the processed data requested by the management server **40**. For example, the name of the processed data, the ID of the processed data, or the like is set in an item for the "processed data name" in the work buffer **11**. The "constituent elements" are identifiers that identify raw data to be used for generating the processed data. For example, the names of the raw data, the IDs of the raw data, or the like are set in items for the "constituent elements" in the work buffer **11**. The "reception states" are information that indicates whether or not the mobile terminal **10** has received the raw data from the data storage servers **30**. In the example illustrated in FIG. **3**, the processed data with an identifier "PD_**1**" may be generated from the raw data with identifiers "RD_**1**", "RD_**2**", "RD_**3**" and "RD_**4**". In the example illustrated in FIG. **3**, the raw data with the identifiers "RD_**1**" and "RD_**3**" has been received, and the raw data with the identifiers "RD_**2**" and "RD_**4**" is yet to be received.

The association list **12** stores information that indicates an association relationship between a unique ID assigned to the processed data and the raw data that constitutes the processed data. The association list **12** is generated by the list generation unit **15** or the like. FIG. **4** is a diagram illustrating an example of the information stored in the association list **12**. As illustrated in FIG. **4**, the association list **12** includes "the processed data name, the unique ID and the constituent elements".

The "processed data name" is the identifier that identifies the processed data requested by the management server **40**. For example, the name of the processed data, the ID of the processed data, or the like is set in an item for the "processed data name" in the association list **12**. The "unique ID" is an identifier that identifies the processed data. The "constituent elements" are the identifiers that identify the raw data to be used for generating the processed data. For example, the names of the raw data, the IDs of the raw data, or the like are set in items for the "constituent elements" in the association list **12**. The example illustrated in FIG. **4** indicates that a unique ID "001" is assigned to the processed data that has the identifier "PD_**1**" and has been generated from the raw data with the identifiers "RD_**1**", "RD_**2**", "RD_**3**" and "RD_**4**". Thus, the raw data with the identifiers "RD_**1**", "RD_**2**", "RD_**3**" and "RD_**4**" may be identified by the unique ID "001".

The wireless communication unit **13** is a processing unit that executes the near field wireless communication by using Wi-Fi or the like. For example, while operating a near field wireless communication function, the wireless communication unit **13** detects another device located close enough to the wireless communication unit **13** to communicate with the wireless communication unit **13**. The wireless communication unit **13** notifies the processing units that the wireless communication unit **13** has detected a device wirelessly communicable with the mobile terminal **10** and notifies the processing units of information regarding the detected device.

The request reception unit **14** is a processing unit that receives various requests from the management server **40** detected by the wireless communication unit **13**. For example, the request reception unit **14** receives a processing request from the management server **40** and outputs the processing request to the list generation unit **15**. The request reception unit **14** receives, from the management server **40**, an ACK indicating a deletion request and outputs the ACK to the ID notification unit **17**.

The list generation unit **15** is a processing unit that generates an association relationship between the processed data and the raw data on the basis of the processing request. For example, the list generation unit **15** extracts, from the processing request received by the request reception unit **14**, the identifier of the processed data, the identifiers of the raw data to be used for generating the processed data, and the like. Then, the list generation unit **15** generates information regarding the association relationship between the processed data and the raw data, in which the extracted identifier of the processed data is associated with the extracted identifiers of the raw data.

The ID assignment unit **16** is a processing unit that assigns a unique ID to the association relationship generated by the list generation unit **15**. When the list generation unit **15** generates a relationship between the processed data and the raw data, for example, the ID assignment unit **16** issues a unique ID for the relationship. In other words, the ID assignment unit **16** issues the unique ID for the processed data. The ID assignment unit **16** generates the association list **12** in which the identifier of the processed data, the identifiers of the raw data, and the unique ID are associated with one another. In addition, the ID assignment unit **16** notifies the ID notification unit **17** that the association list **12** has been generated.

The ID notification unit **17** is a processing unit that transmits the unique ID to the data storage servers **30**. Specifically, the ID notification unit **17** transmits the unique ID corresponding to the data to be used for generating the processed data or the unique ID corresponding to the data to be deleted, through the near field wireless communication using Wi-Fi or the like.

For example, when the association list **12** is generated, the ID notification unit **17** extracts the association relationship between the raw data and the unique ID from the association list **12** and transmits the extracted association relationship to the data storage servers **30**. Upon receiving the unique ID from the request reception unit **14**, that is, receiving the unique ID contained in the ACK transmitted by the management server **40**, the ID notification unit **17** transmits the received unique ID to the data storage servers **30** through the near field wireless communication using Wi-Fi or the like.

The processed data generation unit **18** is a processing unit that generates the processed data in accordance with the processing request received by the request reception unit **14**. For example, the processed data generation unit **18** references the association list **12** to generate information to be used to manage reception states of the raw data to be used for generating the processed data and store the generated information in the work buffer **11**. Specifically, the processed data generation unit **18** generates a table including the processed data name, the constituent elements and the reception states and stores the table in the work buffer **11**.

Then, the processed data generation unit **18** updates the reception states upon receiving the raw data from the data storage servers **30** connected to the mobile terminal **10** through the wireless communication unit **13**. Upon receiving all the raw data to be used for generating the processed data, the processed data generation unit **18** generates the processed data. Note that the processing request includes information regarding the processed data and information regarding the raw data. The processed data generation unit **18** stores the generated processed data in the work buffer **11**.

The processed data transmission unit **19** is a processing unit that transmits the processed data generated by the processed data generation unit **18** to the management server **40** through the near field wireless communication using Wi-Fi or the like. Specifically, when the work buffer **11** has the processed data stored therein and the management server **40** is detected by the wireless communication unit **13**, the pro-

cessed data transmission unit **19** transmits the processed data to the management server **40** by using Wi-Fi or the like. For example, the processed data transmission unit **19** extracts the association relationship between the processed data and the unique ID from the work buffer **11** and transmits the association relationship to the management server **40**.

Configuration of Data Storage Server

Next, a configuration of the data storage server **30** illustrated in FIG. **1** will be described. FIG. **5** is a functional block diagram illustrating a configuration of the data storage server **30**.

As illustrated in FIG. **5**, the data storage server **30** includes an association list **31**, storage **32**, a wireless communication unit **33**, a list reception unit **34**, a data transmission unit **35**, an ACK reception unit **36** and a deletion unit **37**. These processing units of the data storage server **30** are achieved by causing a processor such as a CPU to execute a program. The storage **32** is a storage device such as a memory or a hard disk. The association list **31** is held by a storage device such as a memory or a hard disk.

The association list **31** is received from the mobile terminal **10**. For example, the stored association list **31** includes the "constituent elements" and the "unique ID" that are included in the association list illustrated in FIG. **4**. The association list **31** is stored by the list reception unit **34**.

The storage **32** is a storage device that stores raw data. Data stored in a data storage server **30** may not be the same as data stored in another data storage server **30**. The data stored in the storage **32** is deleted by the deletion unit **37**. A control unit (not illustrated) such as a data generation unit generates the data and stores the data in the storage **32**.

The wireless communication unit **33** is a processing unit that executes the near field wireless communication by using Wi-Fi or the like. For example, while operating a near field wireless communication function, the wireless communication unit **33** detects a mobile terminal **10** located close enough to the data storage server **30** to communicate with the data storage server **30**. The wireless communication unit **33** notifies the processing units that the wireless communication unit **33** has detected a mobile terminal **10** wirelessly communicable with the data storage server **30** and notifies the processing units of information regarding the detected mobile terminal **10**.

The list reception unit **34** is a processing unit that receives the association relationship between the raw data and the unique ID from the mobile terminal **10** detected by the wireless communication unit **33**. For example, upon receiving the association relationship between the raw data and the unique ID, the list reception unit **34** causes the received association relationship to be held as the association list **31** in the data storage server **30**. The list reception unit **34** outputs, to the data transmission unit **35**, information indicating that the association list **31** has been generated.

The data transmission unit **35** is a processing unit that transmits raw data to the mobile terminal **10**. Specifically, when the association list **31** is generated by the list reception unit **34**, the data transmission unit **35** references the association list **31** to identify the raw data to be used for generating the processed data. Then, the data transmission unit **35** reads the identified raw data from the storage **32** and transmits, through the near field wireless communication executed by the wireless communication unit **33**, the raw data to the mobile terminal **10** that has requested the raw data. For example, when the data transmission unit **35** references the association list **31** and identifies the raw data with the identifier "RD_1", the data transmission unit **35** reads the raw data corresponding to the identifier "RD_1" from the storage **32** and transmits the read raw data to the mobile terminal **10**.

The ACK reception unit **36** is a processing unit that receives an ACK from the mobile terminal **10** detected by the wireless communication unit **33**. Specifically, upon receiving an ACK from the mobile terminal **10**, the ACK reception unit **36** extracts the unique ID from the ACK and outputs the extracted unique ID to the deletion unit **37**. For example, the ACK reception unit **36** receives, from the mobile terminal **10**, an ACK transmitted by the management server **40**, extracts a unique ID "001" from the received ACK, and outputs the extracted unique ID "001" to the deletion unit **37**.

The deletion unit **37** is a processing unit that deletes raw data from the storage **32**. For example, upon receiving the unique ID "001" from the ACK reception unit **36**, the deletion unit **37** references the association list **31** and identifies the identifiers "RD_1" and "RD_2" that are associated with the unique ID "001". Then, the deletion unit **37** deletes the raw data corresponding to the identifiers "RD_1" and "RD_2".

The management server **40** has the same configuration as a general management server, and a detailed description thereof is omitted. For example, the management server **40** includes a similar processing unit as the wireless communication unit **33**, a processing unit for transmitting a processing request, and a processing unit for transmitting an ACK. The management server **40** causes information regarding processed data to be generated, a method for generating the processed data, and raw data to be used for generating the processed data to be included in a processing request and transmits the processing request to the mobile terminal **10**. In addition, the management server **40** transmits an ACK containing a unique ID corresponding to data to be deleted to the mobile terminal **10**.

Data Processing

Next, a sequence of data processing that is executed by the system illustrated in FIG. **1** will be described. FIG. **6** is a sequence diagram of the data processing that is executed by the system according to the first embodiment.

As illustrated in FIG. **6**, when a mobile terminal **10** comes into contact with the management server **40** (in S**101** and S**102**), the management server **40** transmits a processing request to the mobile terminal **10** (in S**103** and S**104**). For example, when the wireless communication unit **13** of the mobile terminal **10** detects a radio wave transmitted by the management server **40** and confirms the location of the management server **40**, and the wireless communication unit of the management server **40** detects a radio wave transmitted by the mobile terminal **10** and confirms the location of the mobile terminal **10**, the management server **40** transmits the processing request to the mobile terminal **10**.

When the request reception unit **14** of the mobile terminal **10** receives the processing request (in S**105**), the list generation unit **15** generates, in accordance with the processing request, a list that indicates an association relationship between processed data to be generated and raw data (in S**106**).

Subsequently, the ID assignment unit **16** of the mobile terminal **10** assigns a unique ID to the list generated by the list generation unit **15** to generate an association list **12** (in S**107**). After that, the mobile terminal **10** stands by until a user who holds the mobile terminal **10** transfers to a location near the data storage servers **30** (in S**108**).

After that, when the mobile terminal **10** comes into contact with the data storage servers **30** (in S**109** to S**111**), the ID notification unit **17** of the mobile terminal **10** extracts an association relationship between the raw data and the unique ID from the association list **12** generated by the ID assign-

ment unit **16** and transmits the extracted association relationship to the data storage servers **30** (in S**112** to S**114**).

After that, the list reception units **34** of the data storage servers **30** store, as the association lists **31**, the association relationship between the raw data and the unique ID, which has been received from the mobile terminal **10** (in S**115** and S**116**). Subsequently, the data transmission unit **35** of each data storage server **30** references the association list **31**, reads the raw data held by each data storage server **30** from the storage **32**, and transmits the read raw data to the mobile terminal **10** (in S**117** to S**120**).

Then, the processed data generation unit **18** of the mobile terminal **10** uses the raw data received from the data storage servers **30** to generate the processed data (in S**121**). After that, the mobile terminal **10** stands by until the user who holds the mobile terminal **10** transfers to a location near the management server **40** (in S**122**). When the mobile terminal **10** comes into contact with the management server **40** (in S**123** and S**124**), the processed data transmission unit **19** of the mobile terminal **10** transmits a combination of the generated processed data and the unique ID to the management server **40** (in S**125** and S**126**).

Data Deletion

Next, a sequence of data deletion that is executed by the system illustrated in FIG. **1** will be described. FIG. **7** is a sequence diagram of the data deletion that is executed by the system according to the first embodiment.

As illustrated in FIG. **7**, when a mobile terminal **10** comes into contact with the management server **40** (in S**201** and S**202**), the management server **40** transmits an ACK containing the unique ID to the mobile terminal **10** (in S**203** and S**204**). Upon receiving the ACK (in S**205**), the mobile terminal **10** stands by until a user who holds the mobile terminal **10** transfers to a location near the data storage servers **30** (in S**206**).

After that, when the mobile terminal **10** comes into contact with the data storage servers **30** (in S**207** to S**209**), the ID notification unit **17** of the mobile terminal **10** transmits the ACK containing the unique ID to the data storage servers **30** (in S**210** to S**212**).

In each data storage server **30**, the ACK reception unit **36** extracts the unique ID from the ACK. The deletion unit **37** identifies the raw data associated with the unique ID on the basis of the association lists **31** and deletes the identified raw data from the storage **32** (in S**213** and S**214**).

Flowchart

Next, processes that are executed by the devices according to the first embodiment will be described. Specifically, a process to be executed by a collecting terminal, a process to be executed by a deleting terminal, a process to be executed by the data storage servers **30** and a process to be executed by the management server **40** will be described.

Collecting Terminal

FIG. **8** is a flowchart of the process that is executed by the collecting terminal. The collecting terminal that is described with reference to FIG. **8** has the same configuration as the mobile terminal **10** illustrated in FIG. **2**. As illustrated in FIG. **8**, when the collecting terminal comes into contact with the data storage servers **30** or the management server **40** (Yes in S**301**), the collecting terminal determines whether or not the collecting terminal has received raw data (in S**302**).

When the collecting terminal determines that the collecting terminal has received the raw data (Yes in S**302**), the collecting terminal stores the received raw data in the work buffer **11** (in S**303**) and determines whether it is ready to generate processed data (in S**304**). Specifically, the collecting terminal determines whether or not the collecting terminal has collected all the raw data to be used for generating the processed data. When the collecting terminal determines that it is not ready to generate the processed data, that is, the collecting terminal has not received any of the raw data (No in S**304**), the collecting terminal causes the process to return to S**301** to repeat S**301** and later.

When the collecting terminal determines that it is ready to generate the processed data, that is, the collecting terminal has received all the raw data (Yes in S**304**), the collecting terminal reads the raw data from the work buffer **11** (in S**305**), and processes the raw data to generate processed data (in S**306**).

Subsequently, the collecting terminal associates a unique ID with the generated processed data (in S**307**), and transmits, through the near field wireless communication, the processed data and the unique ID to the management server **40** detected as being wirelessly communicable (in S**308**).

When the collecting terminal determines that the collecting terminal has not received raw data (No in S**302**), the collecting terminal determines whether or not the collecting terminal has received a request to generate processed data, that is, a processing request (in S**309**). When the collecting terminal determines that the collecting terminal has not received a request to generate the processed data (No in S**309**), the collecting terminal causes the process to return to S**301** to repeat S**301** and later.

When the collecting terminal determines that the collecting terminal has received a request to generate the processed data (Yes in S**309**), the collecting terminal extracts information regarding the raw data to be used for generating the processed data from the processing request (in S**310**).

Subsequently, the collecting terminal issues a unique ID for the processed data to be generated (in S**311**) and generates an association relationship between the raw data to be used for generating the processed data and the unique ID (in S**312**). After that, the collecting terminal transmits the generated association relationship to the data storage servers **30** (in S**313**).

Deleting Terminal

FIG. **9** is a flowchart of the process that is executed by the deleting terminal. The deleting terminal that is described with reference to FIG. **9** has the same configuration as the mobile terminal **10** illustrated in FIG. **2**. As illustrated in FIG. **9**, when the deleting terminal comes into contact with the data storage servers **30** (Yes in S**401**), the deleting terminal transmits, to the data storage servers **30**, an ACK received from the management server **40** (in S**402**).

When the deleting terminal does not come into contact with the data storage servers **30** and comes into contact with the management server **40** (No in S**401** and Yes in S**403**), the deleting terminal receives an ACK from the management server **40** (in S**404**) and carries the ACK to the data storage servers **30** along a transfer path of a user who holds the deleting terminal (in S**405**). After that, the deleting terminal causes the process to return to S**401** to repeat S**401** and later. When the deleting terminal comes into contact with none of the data storage servers **30** and the management server **40** (No in S**401** and No in S**403**), the deleting terminal causes the process to return to S**401** to repeat S**401** and later.

Data Storage Servers

FIG. **10** is a flowchart of the process that is executed by each of the data storage servers **30**. As illustrated in FIG. **10**, when a data storage server **30** receives the association relationship between the raw data and the unique ID from the collecting terminal (Yes in S**501**), the data storage server **30** generates a association list **31** on the basis of the received

association relationship and register the generated association list **31** in the data storage server **30** (in S**502**).

The data storage server **30** references the held association list **31**, identifies the raw data stored in the storage **32** of the data storage server **30**, reads the identified raw data from the storage **32** and transmits the read raw data to the collecting terminal (in S**503**).

When the data storage server **30** receives the ACK from the collecting terminal instead of the association relationship between the raw data and the unique ID (No in S**501** and Yes in S**504**), the data storage server **30** extracts the unique ID from the received ACK (in S**505**).

Then, the data storage server **30** references the association list **31** held by the data storage server **30**, identifies the raw data corresponding to the extracted unique ID, and deletes the identified raw data from the storage **32** (in S**506** and S**507**). When the data storage server **30** receives none of the ACK and the association relationship between the raw data and the unique ID from the collecting terminal (No in S**501** and No in S**504**), the data storage server **30** causes the process to return to S**501** to repeat S**501** and later.

Management Server

FIG. **11** is a flowchart of the process that is executed by the management server **40**. As illustrated in FIG. **11**, when the management server **40** receives the processed data from the collecting terminal through the near field wireless communication (Yes in S**601**), the management server **40** extracts the unique ID that has been associated with the processed data (in S**602**). After that, the management server **40** inserts the unique ID into the ACK (in S**603**) and transmits, through the near field wireless communication, the ACK to the deleting terminal detected as being wirelessly communicable with the management server **40** (in S**604**).

Effects

According to the first embodiment, the management server **40** may use transfer path of the user holding the mobile terminal **10** and collect data through the near field wireless communication using Wi-Fi or the like. Since the management server **40** collects data through the near field wireless communication using Wi-Fi or the like, a communication cost may be reduced. In addition, since the management server **40** uses the mobile terminal **10** held by the user, the cost of introducing the system may be reduced.

Second Embodiment

The first embodiment describes the example in which the mobile terminal **10** receives a processing request from the management server **40**, transfers to a location near the data storage servers **30** and generates processed data. Embodiments, however, are not limited to the aforementioned example.

For example, Wi-Fi or ad-hoc communication may be used to carry a processing request transmitted by the management server **40** to a mobile terminal located near the data storage servers **30**. The second embodiment describes examples in which mobile terminals relay a processing request, a deletion request and the like.

FIG. **12** is a diagram describing the flow in which the mobile terminals relay a request. The devices illustrated in FIG. **12** are assumed to communicate by using Wi-Fi or execute ad-hoc communication. Each device periodically transmits a radio wave and determines whether or not another device communicable with each device exists.

As illustrated in FIG. **12**, when the management server **40** detects the mobile terminal MTA located close enough to the management server **40** to communicate with the management server **40**, the management server **40** transmits a processing request to the mobile terminal MTA. At this time, the mobile terminal MTA may generate an association list of processed data to be generated, raw data, and a unique ID on the basis of the processing request.

Then, the mobile terminal MTA transfers to a predetermined location as the user holding the mobile terminal MTA transfers. And there, when the mobile terminal MTA detects the mobile terminal MTB located close enough to the mobile terminal MTA to communicate with the mobile terminal MTA, the mobile terminal MTA transfers the processing request to the mobile terminal MTB. At this time, the mobile terminal MTA may transmit the association list to the mobile terminal MTB instead of the processing request.

After that, the mobile terminal MTB transfers, while holding the processing request or the association list, to a certain location as the user holding the mobile terminal MTB transfers. And there, when the mobile terminal MTB detects the data storage servers **30** located close enough to the mobile terminal MTB to communicate with the mobile terminal MTB, the mobile terminal MTB transmits the association list or the processing request to the data storage servers **30** and collects raw data. Then, the mobile terminal MTB holds the processed data, the raw data, and the unique ID in association with one another.

After that, in a similar method to the aforementioned method, an association relationship between the processed data generated by the mobile terminal MTB and the unique ID is transmitted from the mobile terminal MTB through another mobile terminal to the management server **40**. The management server **40** that has received the processed data transmits an ACK containing the unique ID to a mobile terminal neighboring the management server **40**. The ACK is transmitted to the data storage servers **30** by a similar method to the method described with reference to FIG. **12**. Thus, even when the mobile terminals relay various requests, a common unique ID within the system may be transferred, and the amount of traffic may be suppressed.

FIG. **13** is a diagram illustrating an example in which the mobile terminal MTB collects raw data through another mobile terminal. The devices illustrated in FIG. **13** have similar functions to the devices illustrated in FIG. **12**.

As illustrated in FIG. **13**, when the management server **40** detects the mobile terminal MTA located close enough to the management server **40** to communicate with the management server **40**, the management server **40** transmits a processing request to the mobile terminal MTA. At this time, the mobile terminal MTA may generate an association list of processed data to be generated, raw data, and a unique ID on the basis of the processing request.

Then, the mobile terminal MTA transfers to a predetermined location as the user holding the mobile terminal MTA transfers. And there, when the mobile terminal MTA detects the mobile terminal MTB located close enough to the mobile terminal MTA to communicate with the mobile terminal MTA, the mobile terminal MTA transfers the processing request to the mobile terminal MTB. At this time, the mobile terminal MTA may transmit the association list instead of the processing request.

After that, the mobile terminal MTB transfers, while holding the processing request or the association list, to a certain location as the user holding the mobile terminal MTB transfers. And there, when the mobile terminal MTB detects a part of the data storage servers **30**, which is located close enough to the mobile terminal MTB to communicate with the mobile terminal MTB, the mobile terminal MTB transmits the association list or the processing request to the detected a part of

the data storage servers **30** and collects a part of raw data to be used for generating the processed data.

And there, when the mobile terminal MTB detects a mobile terminal MTC located close enough to the mobile terminal MTB to communicate with the mobile terminal MTB, the mobile terminal MTB transmits the association list or the processing request to the detected mobile terminal MTC and requests the mobile terminal MTC to collect the raw data.

When the mobile terminal MTC detects a part of the data storage servers **30**, which is located close enough to the mobile terminal MTC to communicate with the mobile terminal MTC, the mobile terminal MTC transmits the association list or the processing request to the detected a part of the data storage servers **30** and collects a part of the raw data. Then, the mobile terminal MTC transmits the collected raw data to the mobile terminal MTB.

After that, the mobile terminal MTB uses the raw data collected by the mobile terminal MTB and the raw data received from the mobile terminal MTC to generate the processed data. Then, the mobile terminal MTB holds the processed data, the raw data, and the unique ID in association with one another. After that, an association relationship between the processed data and the unique ID is carried to the management server **40** by using the method described with reference to FIG. **12**.

As described above, even when a mobile terminal may communicate with only a part of the data storage servers **30**, the mobile terminal may collect raw data by using another mobile terminal. Thus, the mobile terminal may collect raw data by using a method appropriate for states of radio waves in wireless communication, generate processed data and transmit the processed data to the management server **40**.

Other Embodiments

The first and second embodiments have been described above. However, other various embodiments may be achieved. Thus, other embodiments will be described below.

Timing of Generation of Unique ID

The first embodiment describes the example in which a unique ID is assigned to processed data to be generated when a processing request is received. The timing of assigning the unique ID is not limited to this. For example, after the mobile terminal **10** collects raw data from the data storage servers **30** and generates processed data, the mobile terminal **10** may assign a unique ID to the processed data and generate an association list. The timing of assigning the unique ID may be arbitrarily changed on the basis of a processing load of the mobile terminal **10** or the like.

Data to be Transmitted in Real Time

After the mobile terminal **10** collects raw data from the data storage servers **30** and generates processed data, the mobile terminal **10** may determine, on the basis of the type of the processed data or the like, whether or not the processed data is data to be transmitted in real time. When the mobile terminal **10** determines that the processed data is data to be transmitted in real time, the mobile terminal **10** may transmit the generated processed data to the management server **40** through a 3G network or the like instead of the near field communication using Wi-Fi or the like. When the mobile terminal **10** determines that the processed data is not data to be transmitted in real time, the mobile terminal **10** transmits the generated processed data to the management server **40** through the near field wireless communication using Wi-Fi or the like.

In this manner, the mobile terminal **10** may transmit urgent processed data to the management server **40** without a delay. Examples of data to be transmitted in real time are processed data with an error, processed data with a high probability of occurrence of an error, and processed data that is not properly generated.

Mobile Terminals

The embodiments describe the examples in which the mobile terminals are mobile phones, smart phones or the like. However, other terminals may be used as the mobile terminals. For example, in-vehicle devices may be used as the mobile terminals. When the in-vehicle devices are used as the mobile terminals, other wireless communication may be used instead of Wi-Fi or the like.

Timing of Deletion

The embodiments describe that a single unique ID is associated with a single raw data item. When the management server **40** transmits a plurality of processing requests, a plurality of processed data items may be associated with a single raw data item. In this case, the data storage servers **30** may delete the raw data item when the data storage servers **30** receive all unique IDs, that is, ACKs corresponding to the processing requests. The data storage servers **30** may keep, without deleting, the raw data item corresponding to the unique ID contained in the ACK and may treat the raw data item as a data item that is not provided to a mobile terminal.

System

Among the processes described above in the embodiments, all or a part of the processes that are automatically executed may be manually executed. All or a part of the processes that are manually executed may be automatically executed by using a known method. The process procedures, the control procedures, the specific names and the information including the various types of parameters and data, which are described in the embodiments or illustrated in the drawings, may be arbitrarily changed unless otherwise specified.

The constituent elements of the devices illustrated in the drawings are functionally conceptual and need not be physically configured as illustrated. Specifically, specific forms of separation and integration of the constituent elements of the devices are not limited to those illustrated in the drawings, and all or a part of the constituent elements of the devices may be functionally or physically separated or integrated on an arbitrary basis on the basis of various types of loads or usage states. All or a part of the various processing functions that are executed by the devices may be achieved by CPUs analyzing and executing programs. Or, all or a part of the various processing functions that are executed by the devices may be achieved as hardware by a wired logic.

Hardware Configurations

Next, a hardware configuration of a mobile terminal will be described. The devices illustrated in FIG. **1** have similar configurations. Thus, a hardware configuration regarding a mobile terminal will be described below, and detailed descriptions of hardware configurations regarding other devices are omitted.

FIG. **14** is a diagram illustrating an example of a hardware configuration of a mobile terminal. As illustrated in FIG. **14**, a mobile terminal **100** includes a communication controller **100***a*, a physical layer (PHY) **100***b*, a bus interface **100***c*, a memory **100***d* and a CPU **100***e*.

The communication controller **100***a* is a processing unit that executes the near field wireless communication with other devices. For example, the communication controller **100***a* is an antenna or a network interface card. The PHY **100***b* is a physical layer hardware part. Operations related to a network connection and data transmission in the physical layer are defined in the PHY **100***b*. The PHY **100***b* achieves

wireless communication with another device through the communication controller **100***a*. The PHY **100***b* may be provided as software.

The bus interface **100***c* is used to transmit and receive signals to and from the CPU **100***e*, the memory **100***d*, the PHY **100***b* and the like. The memory **100***d* is a storage device that includes a read-only memory (ROM) and a random access memory (RAM) and stores the association list, the data obtained in the processes and a program that causes the CPU **100***e* to execute various processes in a data collection method according to the embodiments. The CPU **100***e* is a processing unit that implements the various processes of the mobile terminal **100** and executes the various processes in the data collection method according to the embodiments.

The CPU **100***e* reads programs for executing the processes of the processing units illustrated in FIGS. **2**, **5**, and the like. Then, the CPU **100***e* loads the read programs in the RAM and runs processes that execute the functions described with reference to FIGS. **2**, **5**, and the like. Specifically, the processes execute similar functions to functions of the request reception unit **14**, the list generation unit **15**, the ID assignment unit **16**, the ID notification unit **17**, the processed data generation unit **18**, and the processed data transmission unit **19**. In addition, the processes execute similar functions to functions of the list reception unit **34**, the data transmission unit **35**, the ACK reception unit **36** and the deletion unit **37**. The mobile terminal **100** reads and executes the programs and thereby operates as an information processing device that executes the data collection method.

All examples and conditional language recited herein are intended for pedagogical purposes to aid the reader in understanding the invention and the concepts contributed by the inventor to furthering the art, and are to be construed as being without limitation to such specifically recited examples and conditions, nor does the organization of such examples in the specification relate to a showing of the superiority and inferiority of the invention. Although the embodiments of the present invention have been described in detail, it should be understood that the various changes, substitutions, and alterations could be made hereto without departing from the spirit and scope of the invention.

What is claimed is:

1. A data collection method, comprising:

requesting a device to transmit data, by a first mobile terminal, on the basis of a processing request transmitted from a management server;

transmitting, by the device, the requested data to the first mobile terminal;

receiving, by the first mobile terminal, the transmitted data;

generating, by the first mobile terminal, processed data by using the received data;

assigning, by the first mobile terminal, an identifier to the processed data;

transmitting, by the first mobile terminal, the processed data in association with the identifier to the management server;

transmitting, by the first mobile terminal, an association relationship between the identifier and the data used for generating the processed data to the device;

storing, by the device, the identifier in association with the transmitted data;

transmitting to the device, by a second mobile terminal, an identifier transmitted from the management server as an identifier associated with data to be deleted;

receiving, by the device, the identifier transmitted from the second mobile terminal; and

identifying, by the device, data associated with the received identifier.

2. The data collection method according to claim **1**, further comprising:

determining, by the first mobile terminal, whether the processed data is urgent data, wherein

the first mobile terminal transmits the processed data to the management server through near field wireless communication when the first mobile terminal determines that the processed data is not urgent data, and

the first mobile terminal transmits the processed data to the management server through a communication line for a mobile phone when the first mobile terminal determines that the processed data is urgent data.

3. The data collection method according to claim **1**, wherein

the device deletes, when another identifier is associated with to-be-deleted data that is associated with the received identifier, the to-be-deleted data after receiving all of identifiers associated with the to-be-deleted data.

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